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Spatio-Temporal Variability of Vehicular Noise Pollution Across Days of The Week in Port Harcourt Metropolis of Rivers State, Nigeria

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Abstract

This study examined the spatio-temporal variability of vehicular noise pollution across different days of the week in Port Harcourt metropolis of Rivers State, Nigeria.The study employed both quasi-experimental and descriptive approaches to arrive at the dependable conclusion. The Noise Level Meter (NLM) was used to derive the noise level data sets. At the sample locations of roundabouts and junctions, vehicles were counted. The Global Positioning System (GPS) was employed to ascertain the sample points of the roundabouts and junctions. Thus, the Analysis of Variance (ANOVA) was used to establish whether there exists variation of noise pollution across days of the week. The findings showed that Tuesday (88.3dB) had the highest vehicular noise pollution level, seconded by Monday (87.9dB) and thirdly by Wednesday (84dB). The weekend had the least vehicular noise pollution such that Sunday (72.6dB) had the least vehicular noise pollution, followed by Saturday (74.3dB) respectively. The analysis proved that there was no statistically significant variation in the vehicular noise pollution across the days of the week. The black spot and safety management framework were recommended to curb the disaster of vehicular noise pollution in Port Harcourt metropolis without further delay.

Keywords: Spatio-Temporal, Vehicle, Noise, Pollution, Week

1.0 Introduction

Globally, the appearance of vehicular noise pollution has become unnoticeable to the public but it is a serious health hazard. Rise in vehicular noise has been linked to intensive noise pollution across cities of the world. Since the 1950, Port Harcourt metropolis has been observed to have astronomical rise in vehicular flow in and out of the city due to heavy industrial and general economic activities taking place in the city (Emenike and Orjinmo, 2017). Thus, every year over 466 million people suffer for vehicular noise pollution of which those between 12 to 35 years risk more of their lives to vehicular noise; and it costs the world over $750 billion each year (World Health Organization [WHO], 2020). Therefore, such rise in the population of vehicles in Port Harcourt metropolis will result to increase vehicular pollution that is very dangerous to the human health. However, many vehicles using the roads of Port Harcourt metropolis are not road worthy as such are not adequately intercepted by Road Safety Officials (RSO) who lack the ability to enforce vehicular noise pollution laws in the metropolis (Vibhav, Abhishek, Atul and Asad (2018)

Vehicular noise pollution has greatly introduced serious health hazard to the city dwellers cutting across health issues such as hearing impairment, blood pressure, irregular heartbeat, ulcer, sleeplessness, stress, low work performance and misunderstanding (Stansfeld, Haines and Brown, 2000; Passchier-Vermeer and Passchier, 2000; Quis, 2001). Vehicular noise pollution has exposed pregnant women to the risk of preeclampsia disease (Nathalie, Mathilde, Marianne, Ernest and Audrey, 2018). It is noteworthy that vehicular noise pollution can cause bad social conduct, different kind of cardiovascular diseases, loss of memory, reading interruption, create annoyance, cause psychiatric ailments and brain damage as well as hypertension (Evans and Hygge, 2000).

Vehicular poise pollution can spread across different hours of the day, days of the week and weekend respectively. However, limited number of studies have deeply studied the characteristics of noise pollution and the resultant effects on the city dwellers by using the space time technique (Karina, Maria & Rui, 2015). However, vehicular noise pollution is a collection of different attributes and noise generating activities taking place in commuter vehicles such as noise from the engine, vehicles loud speakers, traffic jam, passengers banging on the commuter vehicle, noise from vehicles exhaust pipes, etc (Smargiassi, Berrada, Fortier and Kosatsky, 2006; Abbott, Tyler and Layfield, 1995). In this vein, this study objective is to analyze spatio-temporal variability of vehicular noise pollution across days of the week in Port Harcourt Metropolis of Rivers State, Nigeria.

2.0 Materials and Methods

Port Harcourt metropolis is lying within latitude 4^{o} 44’ 58.8’’N and 4^{o} 56’ 4.6’’N and longitudes between 6^{o} 52’ 7.2’’E and 7^{o} 7’ 37.7’’E (Figure 2.1). The two Local Government Areas (LGAs), that make up Port Harcourt metropolis are Obo/Akpo (46%) and Port Harcourt (54%), currently having projected population of 1,446,512 (National Population Commission [NPC], 2006) as in Figure 2.2. The location of Port Harcourt is near the Atlantic Ocean in the extreme south-south of Nigeria bounded with the state of Abia, Imo, Bayelsa and Akwa Ibom respectively. The cool environment of Port Harcourt metropolis results from the sea to land

breeze of the Atlantic Ocean. Thus, the metropolis has mean temperature range of 25°C to 28°C per annum with 85% humidity capacity and 2500mm rainfall per annum (Nwaerema and Nwagbara, 2018; Ogbonna, Amangabara and Ekere, 2007). Port Harcourt terrain is characterized with low lands with little or no slope making the metropolis vulnerable to flooding. The mangrove trees and tropical rainforest dominate the surrounding of Port Harcourt metropolis. The dominant soil types of the metropolis are the sandy and sandy-loamy which can easily leach to the underground basement complex structure. (Nwankwola and Ngah, 2014). The soil characteristics enables water infiltration which supports the plant species for a good ecosystem (Ebiegberi and Abi, 2002). Port Harcourt metropolis has attracted influx of vehicles due to the booming economy of oil and gas industrial activities and other rapid economic engagements.

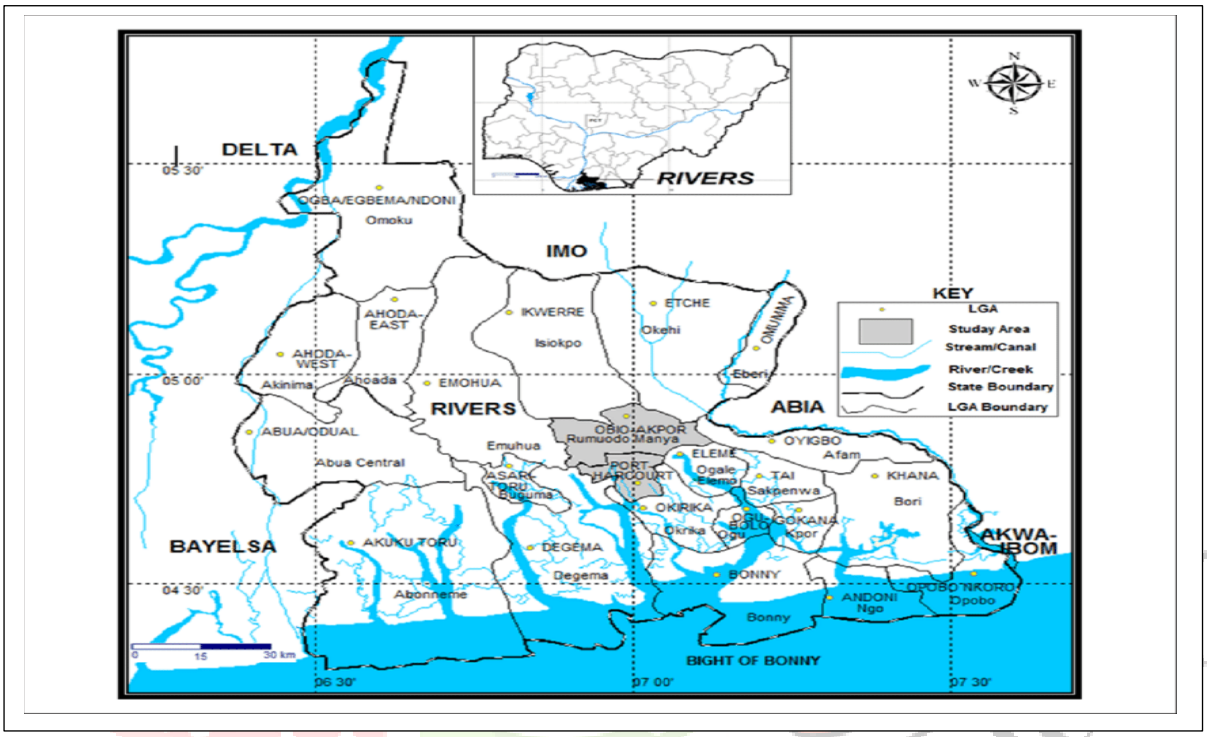

Figure 2.1: Study Area of Port Harcourt metropolis in Rivers State
Source: Adapted from Akukwe & Ogbodo (2015)

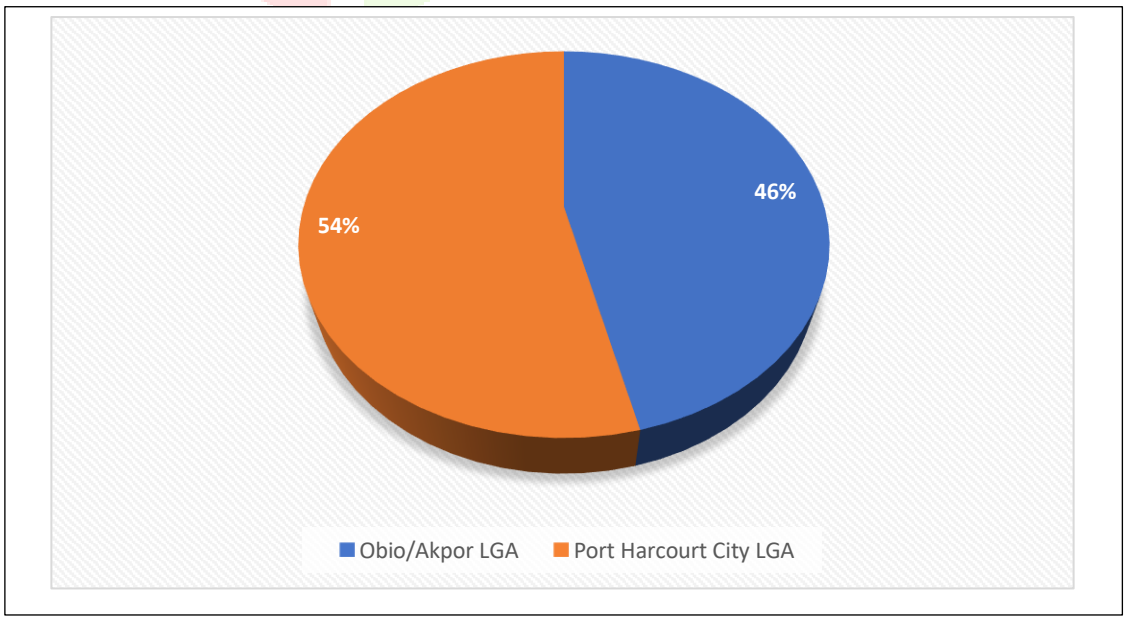

Figure 2.2: Projected Population of Port Harcourt and Obio/AkporLGAs
Source: NPC (2006)

This study was observatory and descriptive. Three sets of data were collected for this study. First the Global Positioning System (GPS) was used to locate the road junctions and roundabouts where the vehicular noise and traffic counts were carried out. Second, at the point of coordinate locations, vehicular count was undertaken. Third, vehicular noise level was taken with the Noise Level Meter (NLM). The location, vehicular traffic counts and noise level were carried out on 9 roads (5 junctions and roundabouts per road) summing all to 45 sample points in Port Harcourt metropolis (Figure 2.3). The noise level meter was raised at the height of 1.20 meters and distance from the road at 2 -3 meters. The selected times of observation were morning (7:00- 8:00am), afternoon (14:00-15:00pm) and evening (17:00-18:0 pm) for a period of one month using the Septa Square 15-minute measurement period. The purposively selected 9 roads were Aba road, East-West Road, Ikwerre-Airport Road (Trunk A), Ada George road, Transamadi road, Aggrey road (Trunk B) and Rumuolumeni-Ogbogoro-Ozuoba Road, Borokiri, road and Woji roads respectively (Trunk C) as in Table 2.1. The Trunk A were Federal roads linking Port Harcourt to other states of Nigeria. Trunks B and C were internal linking roads in Port Harcourt metropolis. The counted vehicles were identified as Car, Van, Lorry and Tricycle (Zuhdi and Hussein, 2012; Serkan, Hasan, Murat and Pervin, 2009; Emenike and Orjinmo, 2017). However, the mean noise level of the hourly vehicular traffic noise was calculated and recorded. The Analysis of Variance (ANOVA) was used to establish the variation in vehicular noise pollution across different days of the week (Monday to Sunday) with Null hypothesis (Ho) that: there is no statistically significant difference in vehicular noise pollution across different days of the week.

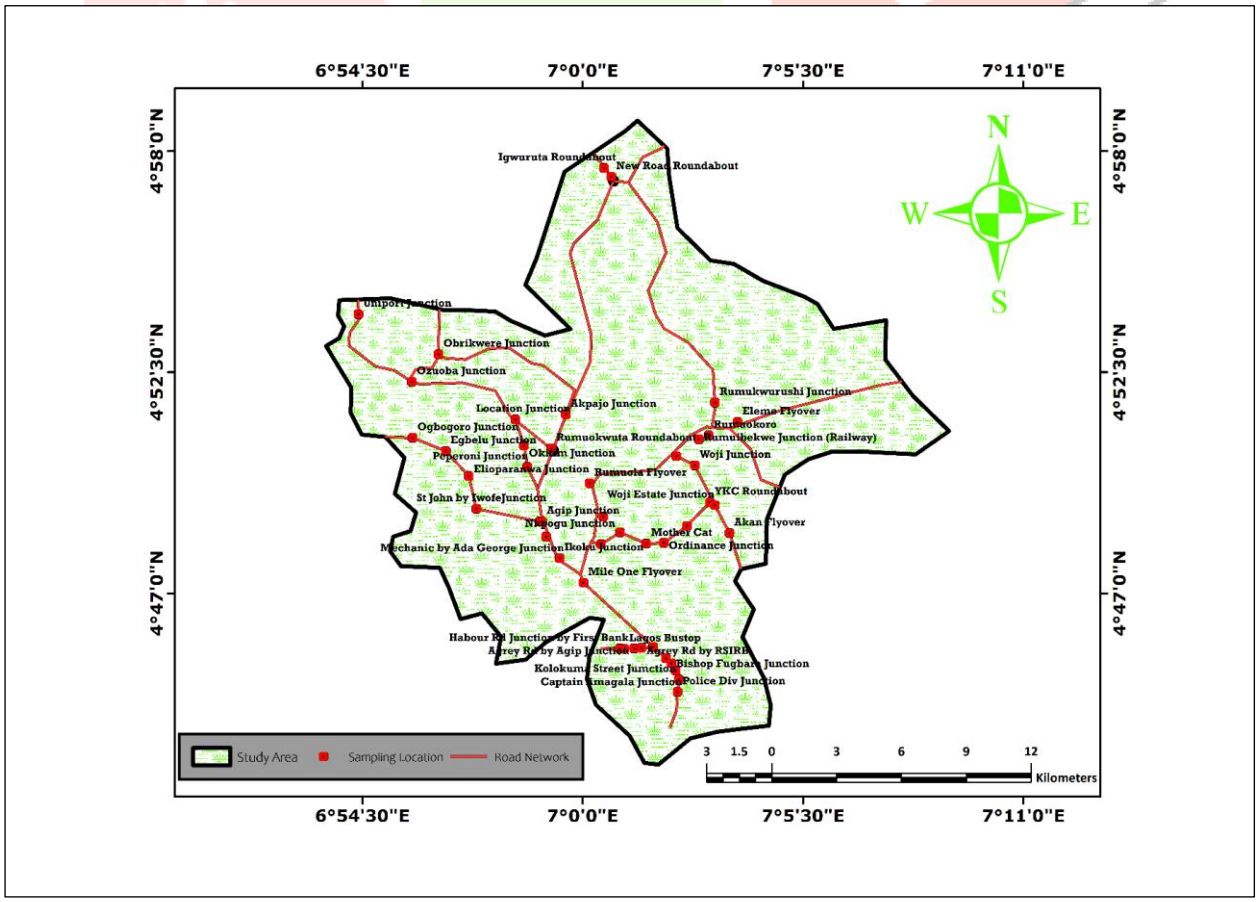

Figure 2.3: Sample Locations map across Different Observation Sites

Table 2.1: Sampled Road Classification, Roundabouts/Junctions and GPS Coordination

Road Trunks (A, B, C)	Name of Roundabout/Junction	GPS Coordinate Easting	GPS Coordinate Northing
Trunk A (Federal Roads)			
Aba Road	Eleme Flyover	285338	536825
	Artillery Junction	282518	535270
	Rumuola Flyover	278505	534039
	Waterlines Junction	279129	532505
	Mile One Flyover	278205	529486
Airport/Ikwerre Road	Igwuruta Roundabout	279218	548482
	New Road Roundabout	279556	548081
	Rumuokwuta Roundabout	277021	535124
	Agip Roundabout	276189	532292
	Ikoku Junction	277114	530607
East-West Road	Uniport Junction	267862	541818
	ObrIkwerre Junction	273081	539137
	Rumuokoro	284016	536217
	Rumukwurushi Junction	284298	537719
	Akpajo Junction	280534	537270
Trunk B (State Roads)			
Aggrey Road	Lagos Bustop	280085	526449
	Habour Rd Junction by First Bank	279878	526458
	Aggrey Rd by Agip Junction	280545	526464
	Aggrey Rd by RSIRB	280885	526482
	Aggrey Rd by Post Office	281420	526530
Trans-Amadi Road	Garrison Junction	279027	531237
	Nkpogu Junction	279905	531786
	Mother Cat	281110	531271
	Ordinance Junction	281924	531302
	Slaughter Roundabout	282998	532069

Road Trunks (A, B, C)	Name of Roundabout/Junction	GPS Coordinate Easting	GPS Coordinate Northing
Ada-George Road	Location Junction	274406	536606
	Okitim Junction	275482	535773
	Peperoni Junction	275634	534790
	Agip Junction	276304	532299
	Mechanic by Ada George Junction	276491	531600
Trunk C (Neighborhood Roads)			
Borokiri Road	ThumsonNumbere Junction	282010	526005
	Police Div Junction	282540	524463
	Kolokuma Street Jumction	282598	525027
	Captain Amagala Junction	282459	525440
	Bishop Fugbara Junction	282254	525779
Woji Road	Woji Junction	283362	534849
	Rumuibekwe Junction (Railway)	283548	536045
	YKC Roundabout	284054	533147
	Woji Estate Junction	284281	533019
	Akan Flyover	284961	531734
Rumuolumeni-Ogbogoro-Ozuoba Road	St John by Rumuolumeni Junction	273277	532883
	Elioparanwa Junction	272931	534389
	Ogbogoro Junction	270339	536146
	Egbelu Junction	271869	535538
	Ozuoba Junction	270321	538717

3. 0 Results and Discussions

The result of this study indicated that vehicular noise pollution across days of the week was highest on Tuesday at 88.3dB (Figure 3.1). Monday was the day with the second highest value of vehicular noise pollution having 87.9dB, thirdly by Wednesday which had 84dB showing that the beginning part of days of the week had the highest vehicular noise pollution compared to the later part of the weekdays (Thursday to Sunday). On the other hand, Sunday 74.3dB had the least level of vehicular noise pollution due to the suspicion that Sunday was usually a resting day. The noise level pollution started rising from Monday (87.9dB), Tuesday (88.3dB), Wednesday (84dB) with a sharp decrease on Thursday (77dB) and increased on Friday (82dB) and dropped on Saturday (74.3dB) as well as Sunday (72.6dB) respectively. The rise in vehicular noise pollution on Monday was as a result of people resuming duty on Monday, school reopening and other economic activities that resulted to increase in vehicular flow across the various roads of Port Harcourt metropolis. Also, the rise in vehicular noise pollution on Friday resulted from rise in weekend traffic as people began returning to their various residents and destinations after the week duties and responsibilities. The fall in vehicular noise pollution in the midweek was suspected to exist due to the variation in socio-economic activities that dropped during the later part of the week especially on Thursday (77dB).

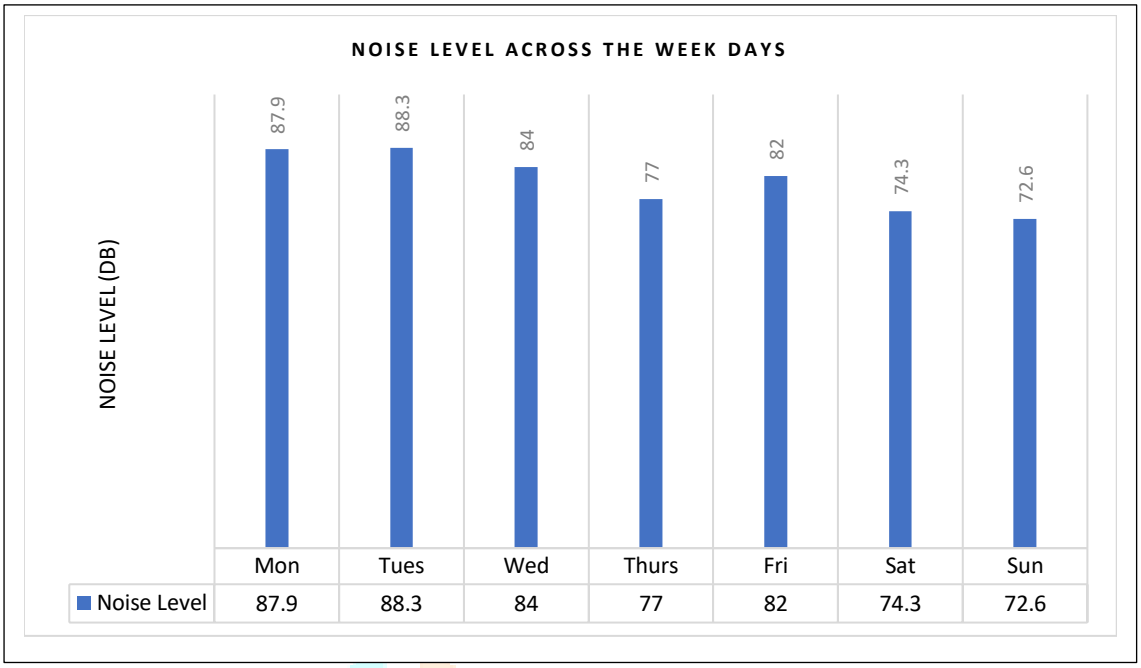

Figure 3.1: Vehicular Noise Pollution Across Days of the Week

The hypothesis established that there is no statistically significant difference in vehicular noise pollution across different days of the week. The calculated value of vehicular noise pollution across the week had F-value of 1.667595026 and critical t-value of 2.215642 with 6 Degree of Freedom (DF) for a two-tailed test at 0.05 Significant Level (SL) (Table 3.1). This result showed that the calculated value of 1.667595026 is lesser than the critical table value of 2.215642 indicating that there was no statistically significant variation in the level of vehicular noise pollution across the days of the week. The result opposed the previous understanding that there were serious differences in vehicular noise pollution across the week, where Tuesday (88.3dB) had the highest vehicular noise level, Monday (87.3dB) and Wednesday (84dB) respectively; showing that the beginning part of the days of the week had the highest noise pollution level than the later part of the weekdays. The analysis, therefore, showed that the differences in vehicular noise pollution was not statistically significant enough to induce vehicular noise variation across the weekdays.

Table 3.1: ANOVA Test Explaining Vehicular Noise Pollution across different Days of the Week

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2294.586	7	327.798	1.667595026	0.133011	2.156424
Within Groups	12580.44	64	196.5693			
Total	14875.02	71				

4.0. Conclusion

From the findings, Tuesday (88.3dB) has the highest vehicular noise pollution level, seconded by Monday (87.9dB) and thirdly by Wednesday (84dB). The weekend has the least vehicular noise pollution as Sunday (72.6dB) has the least vehicular noise pollution, followed by Saturday (74.3dB) respectively. The spread of vehicles and noise pollution are not the same across the days of the week but depend on the time and the day that the city dwellers find themselves. First it is recommended that the black spot strategy should be used to improve traffic noise pollution and safety by creating speed humps, junctions and roundabouts at strategic locations. The second approach is to develop and implement a road-safety management framework targeting improving the attitude of road users and the environment. It is obvious, that there is alarming rate of vehicular noise pollution in Port Harcourt metropolis. Therefore, government and other stakeholders should prevent the menace of vehicular noise pollution in Port Harcourt metropolis without further delay.

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